

AMENDMENTS TO THE DRAWINGS:

Please substitute Replacement Sheet 2/6 in the enclosed Appendix for original Sheet 2/6. Replacement Sheet 2/6 extends the lead line from reference character 203 to the water-retaining layer which is the structure shown between water-permeable membrane 201 and holder 206.

REMARKS

Applicants have amended their specification to refer to cooling pump "615" in Fig. "6". In view of this amendment to the specification, it is respectfully submitted that the required correction set forth in Item 4 on page 2 of the Office Action mailed March 14, 2006, has been made.

Applicants have amended the title of the above-identified application to be indicative of the invention to which the claims are directed, that is, to be a fuel cell "with humidifier". In view of this new title, it is respectfully submitted that the requirement for a new title, in Item 3 on page 2 of the Office Action mailed March 14, 2006, has been satisfied. Moreover, in view of amendment of the Abstract to recite humidifying at least the "fuel" gas to be fed to the anode; and in view of Replacement Sheet 2/6 with amended Fig. 2, it is respectfully submitted that required corrections in Items 1 and 2 on page 2 of the Office Action mailed March 14, 2006, have been made. In this regard, the contention by the Examiner that references characters "203" and "206" have both been used to designate a holder in the drawings, is respectfully traversed. As is clear from Applicants' specification, reference character 203 designates the water-retaining layer. Note, for example, page 9, lines 10-13 of Applicants' specification. In view of amendment of the lead line in Replacement Sheet 2/6 enclosed herewith, it is respectfully submitted that it is clear as to differences in structure represented by reference characters "203" and "206".

Applicants have amended their claims in order to further clarify the definition of various aspects of the present invention. Specifically, Applicants have cancelled claim 1 without prejudice or disclaimer, substituting therefor new claim 18. Claim 18 defines a fuel cell assembly including a stack of unit fuel cells each having a cathode, an anode and a membrane electrolyte, and a humidifier, connected to the

stack, for humidifying fuel gas and oxidizing gas respectively fed to the anode and cathode; claim 18 further recites that a water-retaining layer is disposed to face gas flow channels of the stack to humidify at least one of the fuel and oxidizing gasses and the membrane electrolyte, with the water-retaining layer being made of a hydrophilic porous member having a mean micro-pore diameter of 10-300 μm and a thickness of 50-300 μm . As to mean micro-pore diameter and thickness of the water-retaining layer, note, for example, pages 13 and 14 of Applicants' specification.

In light of canceling of claim 1 and substitution therefor of claim 18, Applicants have amended dependencies of various of the remaining claims. In addition, Applicants have further amended claim 3 to recite said porous "member"; have further amended claim 4 to clarify that the porous material is porous material "of the water retaining layer"; have amended claim 7 to recite that the membrane is selected from the group "consisting" of various materials; and have amended claim 8 to recite that "the water retaining layer of" the humidifier has the recited filter.

Moreover, Applicants have amended claim 12 to recite that the fuel cell assembly includes, inter alia, "a humidifier"; that the humidifier humidifies "at least one of" the oxidizing gas "and the fuel gas"; and that the water-retaining layer with which the humidifier is equipped has a mean micro-pore diameter of 10-300 μm and a thickness of 50-300 μm .

Furthermore, claim 17 has been amended to recite that the humidifier humidifies, inter alia, an oxidizing gas fed to the cathode; that the humidifier has a "hydrophilic" water-retaining layer, consistently referring throughout claim 17 to the water-retaining "layer"; and to recite that this water-retaining layer has a mean micro-

pore diameter of 10-300 μm and a thickness of 50-300 μm , which is provided to the flow channels of the fuel gas "and said oxidizing gas".

In addition to claim 18, Applicants are adding new claims 19-23 to the application. Claim 19, dependent on claim 18, recites that water retained in the water-retaining layer is supplied to the flow channels from at least one of part of the opposed surface of the porous member and the outer periphery of the porous member. Claims 20 and 21, dependent respectively on claims 18 and 8, respectively recites that the fuel cell assembly has at least two water-retaining layers, and recites that the carbonaceous porous filter controls flow rate of water to the water-retaining layer. Note, for example, pages 20 and 25 of Applicants' specification.

New independent claims 22 and 23 respectively set forth the subject matter of claims 14 and 15 in independent form. In light of comments by the Examiner concerning claims 14 and 15, in the paragraph bridging pages 7 and 8 of the Office Action mailed March 14, 2006, it is respectfully submitted that claims 22 and 23 should be allowed. In light of new claims 23 and 23, claims 14 and 15 have been cancelled without prejudice or disclaimer.

Applicants respectfully traverse the rejection of various of their claims under the second paragraph of 35 USC 112, as being indefinite, insofar as applicable to the claims as presently amended. Thus, claim 7 has been amended to provide proper Markush language, and claims 12 and 17 respectively have been amended to recite "a" humidifier and to recite a water-retaining "layer", rendering moot bases for rejection of these claims in Items 8 and 9 on page 3 of the Office Action mailed March 14, 2006. Furthermore, in light of amendments to claims 3 and 4, it is

respectfully submitted that any issues therein in connection with antecedent basis are moot.

The bases for rejection of claims 1, 12 and 17, as set forth in Item 6 on page 3 of the Office Action mailed March 14, 2006, are noted. Noting claim 18, any question concerning feed of "oxidizing gas" to the anode is moot. Moreover, in light of amendments to claim 17, it is respectfully submitted that claim 17 is clear as to the oxidizing gas being fed to the "cathode", with the fuel gas being fed to the "anode".

Questions raised by the Examiner with respect to claim 12, as to whether the humidifier is located within the fuel cell assembly or outside thereof, and also whether the oxidizing gas is supplied to the anode, is noted. Claim 12 recites that the fuel cell assembly includes a humidifier, and thus it is respectfully submitted that claim 12 is sufficiently clear, to satisfy requirements of the second paragraph of 35 USC 112, as to whether the humidifier is included in the claimed fuel cell assembly. The issue raised by the Examiner as to whether the oxidizing gas is supplied to the anode, in claim 12, is noted. Claim 12 as presently amended, while reciting a cathode and an anode, and also reciting that the humidifier humidifies at least one of the oxidizing gas and the fuel gas, does not specifically recite supply of the oxidizing gas or fuel gas to an electrode. It is respectfully submitted that claim 12 is sufficiently clear in connection with the defined structure, so as to satisfy requirements of the second paragraph of 35 USC 112. See In re Moore, 169 USPQ 236 (CCPA 1971).

Applicants respectfully submit that all of the claims presented for consideration by the Examiner patentably distinguish over the teachings of the prior art applied by the Examiner in rejecting claims in the Office Action mailed March 14, 2006, that is,

the teachings of U.S. Patent Application Publication No. US2001/0046616 to Mossman, and the Japanese Patent Documents No. 08-138704 (Kawazu '704), No. 08-138705 (Kawazu '705), and No. 2000-173633 (Karakane), under the provisions of 35 USC 102 and 35 USC 103.

It is respectfully submitted that the references as applied by the Examiner would have neither taught nor would have suggested such a fuel cell assembly, or power generation system, as in the present claims, having, inter alia, a humidifier, and wherein the humidifier is equipped with a water-retaining layer made of a porous member having a mean micro-pore diameter of 10-300 μm and a thickness of 50-300 μm (see claims 12, 17 and 18); in particular, wherein such water-retaining layer having such mean micro-pore diameter and thickness is a hydrophilic porous member (see claims 13, 17 and 18).

Thus, as will be discussed further infra, it is respectfully submitted that according to the present invention a water-retaining layer is provided for the humidifier, and this water-retaining layer has a mean micro-pore diameter of 10-300 μm and a thickness of 50-300 μm .

In addition, it is respectfully submitted that the applied references would have neither disclosed nor would have suggested such a fuel cell assembly as in the present claims, having features as discussed previously in connection with the independent claims 12, 17 and 18, and, moreover, having additional features as in the dependent claims, including (but not limited to) wherein a water permeable membrane having a function to transmit water is formed on porous material of the water-retaining layer (see claim 4); and/or wherein the water-retaining layer of the humidifier has a carbonaceous porous filter (see claim 8), in particular wherein this carbonaceous

porous filter controls flow rate of water to the water retaining layer (see claim 21);
and/or other features of the remaining dependent claims.

In connection with the prior art rejection, the Examiner's attention is respectfully directed to indicated allowance of the subject matter of previously considered claim 14, such previously considered claim 14 reciting that the water-retaining layer is 10-300 micrometers on a mean micro-pore diameter. Compare with each of claims 12, 17 and 18, reciting, inter alia, that the water-retaining layer has a mean micro-pore diameter of 10-300 μm , in addition to reciting a thickness of this water-retaining layer of 50-300 μm . In view of present amendments to claims 12 and 17, and in view of new claim 18, including the water-retaining layer thereof; and noting indication of allowable subject matter of claim 14 set forth in the Office Action mailed March 14, 2006, it is respectfully submitted that all claims presently pending in the application, dependent on one of claims 12, 17 and 18, should be allowed.

In any event, Kawazu '704 discloses a fuel cell humidifier constituted with a porous film 111, and separators 113, 115 which interpose the porous film 111 from both sides and form a hydrogen gas flow path 113p and a water flow path 115p respectively, the porous film 111 being a polyolefin porous film and having hydrophilic nature. This patent document discloses that the water is easily vaporized by receiving heat from both the porous film 111 and the hydrogen gas, with humidification being conducted in a good state of steam.

Karakane discloses a solid polymer fuel cell which enables maintenance of the wet state of the whole solid polymer film, having a water-holding layer 402 formed on the side facing to a fuel electrode 23 of a rib-equipped plate 40 which forms channels 400, through which water (a wetting agent) flows. This patent document discloses that

a wet-holding capacity per electrode action area of the wet-holding area 402 is regulated to 0.002-0.035 g/cm².

It is respectfully submitted that neither of Kawazu '704 or Karakane would have taught or would have suggested the fuel cell assembly or system as in the present claims, including, inter alia, the mean micro-pore diameter and thickness of the water-retaining layer as in the present claims. In this regard, and particularly with respect to Karakane, note the statement by the Examiner in the sentence bridging pages 7 and 8 of the Office Action mailed March 14, 2006:

"The Karakane reference teaches a fuel cell assembly with a humidifier equipped with a water retaining layer, but it does not expressly teach a water retaining layer that has a mean pore diameter of 10 to 300 micrometers"

Clearly, as stated by the Examiner, Karakane would not have taught, and it is respectfully submitted would not have suggested, the presently claimed invention, including the water-retaining layer.

Of the references applied by the Examiner under 35 USC 103, that is, including Kawazu '705 and Mossman, it is respectfully submitted that the teachings of the applied references would not have rectified the deficiencies of either and/or both of Kawazu '704 and Karakane, such that the presently claimed invention as a whole would have been obvious to one of ordinary skill in the art.

Kawazu '705 discloses a hydrogen gas humidifier 20 constituted with a porous film 21, a catalyst reaction layer 22 formed on its one side surface, and separators 24 which interpose the porous film 21 and the catalyst reaction layer 22 from both sides and form a hydrogen gas flow path 23p and a water flow path 24p respectively. Water in the water flow path 24p permeates the porous film 21 and the catalyst reaction layer 22 due to difference between the pressure of water flowing in the water flow path 24p

and the pressure of hydrogen gas 23p flowing in the hydrogen gas flow path.

Hydrogen gas flows from the hydrogen gas flow path side to the catalyst reaction layer 22 through the porous film 21, and the permeated hydrogen gas reacts with oxygen dissolved in water by the action of the platinum 22a of the catalyst reaction layer and disappears. In connection with Kawazu '705, note the second full paragraph on page 2 of Applicants' specification.

Even assuming, arguendo, that the teachings of Kawazu '705 were properly combinable with the teachings of Kawazu '704, it is respectfully submitted that such teachings would have neither disclosed nor would have suggested the water-retaining layer as in the present claims, and advantages thereof.

Even taking the teachings of Kawazu '704 with the teachings of Karakane, each discussed previously, such combined teachings would have neither disclosed nor would have suggested the presently claimed subject matter, including the micro-pore diameter and thickness of the water-retaining layer, and advantages thereof.

Mossman discloses membrane exchange humidifiers, particularly for use in humidifying reactant streams for solid polymer electrolyte fuel cell systems. The humidifier utilized in connection with a solid polymer fuel cell system is described most generally in paragraph [0017] bridging pages 2 and 3 of Mossman. Note that this paragraph discloses that the membrane comprises a microporous polymer and a hydrophilic additive. In connection with the water permeable membrane, it is described in paragraph [0016] on page 2 of Mossman that the average pore size may be from about 0.025 to about 0.1 micrometers. Note also paragraphs [0012], [0014] and [0015] on page 2 of this published patent application.

Even assuming, arguendo, that the teachings of Mossman were properly combinable with the teachings of Kawazu '704, it is respectfully submitted that the

teachings of these references do not disclose, nor would have suggested, the micro-pore diameter and thickness of the water-retaining layer of the present invention, and advantages thereof as described in the foregoing.

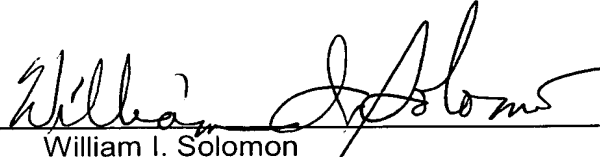
It is emphasized that according to the teachings of the applied references, a water permeable membrane is provided, having a function to transmit water formed on the porous material. In contrast, the present invention recites a water-retaining layer, having a specified mean micro-pore diameter and thickness. While the humidifier of the present invention can additionally include a water permeable membrane (note membrane 201 in Fig. 2), a recited feature in all of the present claims is the water-retaining layer. According to investigation by the present inventors, the micro-pore diameter as in the present claims is important for retaining water and supplying a proper amount of water in the flow channels. Note, for example, pages 13 and 14 of Applicants' specification. As to advantages achieved by the present invention, note the Embodiments of the present invention described starting from page 5, and compare with Comparative Examples on pages 26 and 27, and following pages, of Applicants' specification. Clearly, Applicants show advantages achieved by the present invention, using the water-retaining layer having the mean micro-pore diameter as in the present claims, and also having the recited thickness. In this regard, it is respectfully submitted that the water permeable membrane in various of the references would not function as a water-retaining layer, because of relatively small micro-pore diameter.

In view of the foregoing comments and amendments, reconsideration and allowance of all claims presently pending in the above-identified application are respectfully requested.

Applicants request any shortage in fees due in connection with the filing of this paper be charged to the Deposit Account of Antonelli, Terry, Stout & Kraus, LLP, Deposit Account No. 01-2135 (case 520.43216X00), and credit any excess payment of fees to such Deposit Account.

Respectfully submitted,

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Enclosures: Substitute Abstract (p. 43); Replacement Sheet 2/6 (Fig. 2)

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